EC-G-1998-54

JUN 1 1984

SUBJECT: Benzene NESHAPs Guidance

FROM: Director
Stationary Source Compliance Division
Office of Air Quality Planning and Standards

TO: Air & Waste Management Division Directors
Regions II, IV, VI-VIII, and X

Air Management Division Directors
Regions I, III, V, and IX

Attached are enforcement guidelines for the benzene NESHAPs, which is scheduled to be promulgated on June 4, 1984 and which will regulate benzene equipment leaks from fugitive emission sources. The guidelines summarize the regulations and address potential enforcement problems. All Regions should work with delegated States in identifying affected sources and ensuring those sources are in compliance with the benzene regulations.

The Stationary Source Compliance Division and the Emission Standards and Engineering Division have jointly agreed to present a one day session discussing the benzene NESHAPs, if there is sufficient interest among Regional personnel. The session is tentatively scheduled for Washington during the week of June 18. Please notify Robert Myers at (FTS) 382-2875 if representatives from your Region would be interested in attending such a meeting.

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Attachment

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FEB 25 1998
ECDIC

NESHAPS Enforcement Guideline S-28 - Benzene Equipment Leaks (Fugitive Emission Sources)

Benzene standards are being promulgated under the National Emission Standards for Hazardous Air Pollutants, Section 112 of the Clean Air Act. Standards under this section have already been promulgated for asbestos, beryllium, mercury, and vinyl chloride, and have been proposed for arsenic and radionuclides in addition to benzene. OAQPS has prepared this document to aid in enforcement and implementation of the benzene NESHAPs. This summarizes the benzene equipment being regulated and the standards to which this equipment is subject, and provides guidance on several issues of enforcement concern.

Background

On June 8, 1977 the Administrator declared benzene a hazardous air pollutant and a carcinogenic risk to human health. Standards were later proposed for four sources of benzene emissions. These sources were benzene equipment leaks (fugitive emission sources), proposed 1/5/81, 46 FR 1165, maleic anhydride plants, ethylbenzene/styrene plants, and benzene storage vessels. Further analysis has led EPA to conclude that both the benzene health risks (annual leukemia incidence and maximum lifetime risk) to the public from the latter three source categories and the potential reduction in health risks achievable with available control techniques are too small to warrant action under Section 112 for these three categories. As a result, EPA proposed on March 6, 1984, 49 FR 8386, to withdraw the proposed standards for these three categories. Because of the magnitude of benzene fugitive emissions, the projected increase in emissions as a result of new sources, and the estimated decrease in risks and emissions achievable through controls, EPA found fugitive benzene emissions posed a significant risk and should be regulated.

Introduction

Valves, pumps, flanges and other pieces of equipment are used extensively in the refining and organic chemical industries to move streams of organic compounds to and from various process vessels. Since this type of equipment can develop leaks, each individual piece is a potential source of organic compound emissions whenever it handles a process stream containing such compounds. Benzene fugitive emissions sources are pieces of equipment handling streams that could potentially contain benzene. These include sources that develop leaks after some period of operation due to seal failure as well as other sources that can emit benzene when used in specific conditions in the production unit. The sources that develop leaks due to seal failure are those using a sealing mechanism to limit the escape of organic compounds to atmosphere. These include pumps, valves, flanges, relief valves and compressors. Other types of equipment are potential benzene fugitive emissions sources for reasons other than leaking seals. These types of equipment might have the potential for intermittent benzene emissions because they vent organic materials that contain benzene to atmosphere, and include sampling connections, open-ended valves, and product accumulator vessels.

Scope and Applicability

The standard covers new and existing valves, pumps, compressors, pressure relief devices, sampling connection systems, open-ended valves or lines, pipeline flanges, product accumulator vessels, and closed vent systems and control devices used to comply with the standard. This equipment is used in the production of benzene and other chemicals and products, such as maleic anhydride, ethanol, and pharmaceuticals.

To be covered the equipment must be in benzene service, i.e., it must contain material with a benzene concentration of 10 percent or more by weight. See the compliance issues topic for a discussion of "in benzene service".

Exempted from this standard is equipment located in process units that produce benzene or benzene mixtures at coke by-product plants. These will be covered by other regulations. Additionally, plant sites designed to produce or use benzene in quantities of 1000 Mg/yr or less are exempt from the standard. The source owner or operator has the responsibility of demonstrating to EPA's satisfaction that the site is below the 1000 Mg/yr threshold level. Such a demonstration can be accomplished by engineering analysis as well as by proof of physical limitation of plant capacity.

Controls for new and existing sources are the same. In the case of an existing source or a new source which has an initial startup date preceding the effective date, the standard applies within 90 days of the effective date, unless a waiver is granted pursuant to §61.11.

EPA estimates the standard will affect equipment located in approximately 240 existing process units and an expected 70 new process units by 1985. Attachment 1 lists 131 plant sites EPA has identified as having the potential to emit benzene fugitive emissions. This list is not exhaustive and Regions and States should seek to identify other affected sites and confirm the accuracy of those listed.

Standards

Generic standards for equipment leaks are presented under Subpart V of 40 CFR 61. Subpart J, standards for benzene equipment leaks, requires that affected sources must meet the requirements of Subpart V. Two basic control techniques are employed by the standard to reduce benzene fugitive emissions. These are leak detection and repair programs in which fugitive source leaks are located and repaired at regular intervals, and preventive programs in which potential fugitive sources are eliminated by either retrofitting with specified controls or replacement with leakless equipment. A discussion of the specific standards for each affected piece of equipment follows.

1. Valves. This is one of the most common pieces of equipment in a refinery or organic chemical production unit. It ordinarily is activated by a valve stem requiring a seal to isolate the process fluid from atmosphere. Since the potential for leaks exists, valves are subject to regulation.

A monthly leak detection and repair program is required for valves in gas or liquid service. Gas and liquid service are defined under §61.191. Quarterly monitoring will be allowed for valves that have been found not to leak for two successive months. Leak detection is to be performed with a portable organic vapor analyzer, according to Reference Method 21 of 40 CFR 60, Appendix A. A leak is described as a reading of 10,000 ppm or greater of organic material. Whenever a leak is detected the valve must be tagged until repaired and, at a minimum, must be monitored monthly until a leak is not detected for two successive months.

Initial repair of the leak must be attempted within 5 days, and the repair must be completed within 15 days. Initial repair includes, but is not limited to, the following best practices where practicable:

(1) tightening of bonnet bolts;

(2) replacement of bonnet bolts;

(3) tightening of packing gland nuts; and

(4) injection of lubricant into lubricated packing.

See §61.192-7(e).

An annual leak detection and repair program is required to be developed and followed if the valves are difficult to monitor. The description of this program must be kept in a readily accessible location. Difficult to monitor valves are those that would require elevating the monitoring personnel more than two meters above any permanent available support surface. Valves that cannot be safely monitored by the use of step ladders could be classified as difficult to monitor.

For valves which are unsafe to monitor, an owner or operator is required to develop and follow a plan that defines a leak detection and repair program conforming with the routine monitoring requirements of the standard as much as possible, with the understanding that monitoring should not occur during unsafe conditions. Unsafe to monitor valves are defined as those that could, as demonstrated by the owner or operator, expose monitoring personnel to imminent hazards from temperature, pressure, or explosive process conditions. There should be very few valves in benzene service that are unsafe to monitor.

Two alternative standards are available for valves in gas/vapor and liquid service. The first alternative specifies a two percent limitation as the maximum percent of valves leaking within a process unit, determined by an initial performance test and a minimum of one performance test annually thereafter. Process unit is defined at §61.191. This alternative could be met by implementing any type of program and engineering controls chosen at the discretion of the owner or operator. If the percentage of valves leaking is higher than two percent, the process unit is in violation. If owners or operators decide they no longer wish to comply with this alternative, they must submit written notice to EPA accepting compliance with the monthly/quarterly leak detection and repair program.

The second alternative standard specifies two skip-period leak detection and repair programs. Under this option an owner or operator upon notifying EPA can skip from monthly/quarterly monitoring to something less frequent after completing a specified number of consecutive monitoring intervals with the percentage of valves leaking equal to or less than 2.0. Under the first program, after two consecutive quarterly periods with fewer than two percent of valves leaking, an owner or operator may skip to semiannual monitoring. Under the second program after 5 consecutive quarterly periods with fewer than two percent of valves leaking, annual monitoring may be adopted. An owner or operator cannot adopt semiannual monitoring and then proceed directly to annual monitoring by claiming one period of semiannual monitoring substitutes for two quarterly periods. If the owner or operator finds the two percent level is exceeded, he or she must revert to monthly/quarterly leak detection and repair. If EPA finds the two percent level is exceeded, an evaluation of compliance should occur. This alternative differs from the first alternative because the type of compliance program chosen must be leak detection and repair, rather than a program at the discretion of the owner or operator.

An owner or operator electing to comply with the provisions of either of these options must notify the Administrator 90 days before implementing the option.

Delay of repair for equipment for which leaks have been detected is allowed under certain circumstances. See §61.192-10. There are two general circumstances where repair delays for pumps, compressors and closed-vent systems, as well as for valves, are allowable. The first is where repair is technically or physically infeasible without a process unit shutdown, defined as a work practice or operational procedure stopping production. The use of spare equipment and technically feasible bypassing of equipment without stopping production are not process unit shutdowns. Repair must occur before the end of the next process unit shutdown; hence, only one shutdown may be passed before repair is always required. Repair is required during scheduled shutdowns of any duration and during unscheduled shutdowns of over 24 hours.

The second general circumstance where repair delay is allowed is if the equipment is isolated from the process and no longer contains benzene in concentrations greater than ten percent.

Delay of repair specifically for valves is allowed beyond a process unit shutdown when unforeseeable circumstances deplete valves used for repair. The valve assembly supplies must have been sufficiently stocked before the supplies were depleted. In this case delay of repair beyond the next process unit shutdown will not be allowed unless the next process unit shutdown occurs sooner than six months after the first shutdown. Delay of repair for valves is also allowed if the owner or operator can show that leakage of purged material resulting from immediate repair would be greater than the fugitive equipment leaks likely to result from delay of repair, and that when repairs are effected, the purged material is destroyed or recovered in a control device.

2. Pumps - A pump normally has a shaft that requires a seal to isolate the process fluid from atmosphere. Packed and mechanical shaft seals are most common. If the seal becomes imperfect due to wear, compounds being pumped leak.

Requirements for pumps are similar to those for valves. A monthly leak detection and repair program is required, with detection determined by Reference Method 21. Alternatively, dual mechanical seals may be used under conditions specified at §61.192-2(d). Each pump must be visually inspected weekly for indications of liquid dripping from the pump seal. A reading of at least 10,000 ppm or indication of liquids dripping is a leak.

Initial pump leak repair must be attempted within five days and completed within 15. Delay of repair is allowed for pumps that cannot be repaired without a process unit shutdown and a delay of up to six months after leak detection is allowed when the owner or operator determines that repair requires use of a dual mechanical seal system with barrier fluid system. Any pump equipped with a closed-vent system capable of capturing and transporting any leakage from the seal to a control device is exempt from the requirements.

3. Compressors - Compressors have a shaft that requires a seal to isolate the process gas from atmosphere. The potential for a leak through this seal makes it a potential source of benzene emissions. The standard requires the use of seals with barrier fluid systems that prevent leakage. The barrier fluid system must be equipped with a sensor that will detect failure of the seal or barrier fluid system. Sensors must be checked daily or have an alarm. If the sensor detects a failure, a leak is detected. Leaks must be repaired within 15 days. A compressor is exempt from the above if it is equipped with a closed-vent system transporting leaks to a control device, or it satisfies the no detectable emissions provision at §61.192-3(i).

4. Pressure relief devices in gas/vapor service. The standard requires no detectable emissions, which is a reading of less than 500 ppmv above background based on Reference Method 21. ~~Annual verification is required~~. As an alternative, compliance may be achieved by use of a rupture disk system or closed-vent system capable of capturing and transporting leakage from the pressure relief device to a control device, such as a flare. This standard does not apply to discharges during overpressure relief, but the relief device must be returned to a no detectable emissions status within five days of such a discharge. Additionally, relief valve simmering (wherein the system pressure is close to valve set pressure) is not allowed.

5. Sampling Connection Systems - Product quality and process unit operation is checked periodically by analysis of feedstocks, intermediates, and products. To obtain representative samples for these analyses, sampling lines generally are purged first. If this flushing liquid purge is not returned to the process, it could be drained onto the ground or into a process drain, where it would evaporate and release benzene to atmosphere.

The standard provides for closed-purge sampling to eliminate emissions due to purging by either returning the purge material directly to the process or by collecting the purge in a collection system generally closed to the atmosphere and disposing of it in an appropriately designed control device. Closed-vent vacuum systems connected to a control device and in-situ sampling systems are also allowed.

6. Open-Ended Valves or Lines - Some valves are installed in a system so that they function with the downstream line open to atmosphere. A faulty valve seat or incompletely closed valve would cause leakage through the valve. The use of caps, plugs, or any other equipment that will effect enclosure of the open end is required. If a second valve is used, the standard requires the upstream valve to be closed first. This prevents the trapping of process fluid between the two valves.

7. Product Accumulator Vessels, Flanges, Pressure Relief Devices in Liquid Service - Product accumulator vessels are utilized with fractionation columns, and may be vented directly or indirectly to atmosphere. Flanges are gasket-sealed junctions which may develop seal leaks. Pressure relief devices are designed to release a product material from distillation columns and other pressurized systems during emergency or upset conditions.

The standard for product accumulator vessels effectively requires venting accumulator emissions to a control device, or use of a closed-vent system. Flanges and pressure relief devices in liquid service are excluded from routine leak detection and repair requirements, but if leaks are detected by visual, audible or olfactory techniques, they are subject to the same allowable repair interval as applies to valves and pumps.

8. Closed-Vent Systems and Control Devices - Control devices will be used to reduce benzene equipment leaks captured and transported through closed-vent systems. Reference Method 21 will be used to verify that a closed-vent system has been designed and installed properly. Method 21 requires that closed vent systems be checked visually to ensure there are no leaks where they would not be expected (e.g., in pipes) and also requires the monitoring of connections that are expected to leak occasionally.

Enclosed combustion devices, such as incinerators, catalytic incinerators, boilers, or process heaters must be designed to reduce emissions vented to them with an efficiency of 95% or greater or provide a minimum residence time of 0.50 seconds at a minimum temperature of 760° C. Vapor recovery systems such as carbon adsorbers or condensation units must be designed and operated to recover the organic vapors vented to them with an efficiency of 95% or greater. As an alternative the use of smokeless flares designed for and operated with no visible emissions is allowed. Specific flare conditions established at §61.192-11(d) and §61.195(e) must be met and destruction efficiency must be over 95%. Equipment purges from valves, pump seals, compressor seals, pressure relief devices, sampling connection systems, and product accumulator vessels must be vented to a system complying with the requirements of the control device portion of the standard.

Closed-vent systems must be designed and operated with no detectable emissions, as indicated by an instrument reading of below 500 ppm above background and by visual inspections. See §61.195(c). They shall be monitored initially, annually, and at other times requested by the Administrator. Leaks must be repaired as soon as practicable, but not later than 15 days after detection, with a first attempt no later than five days after detection.

Equivalent Means of Emission Limitation

Each owner or operator may apply to the Administrator for determination of equivalence for any means of emission limitation that achieves a reduction at least equivalent to the reduction achieved by the required controls. Guidelines for the determination of equivalence are provided at §61.194(b) and (c). Acceptance of such an equivalent method must be approved by the Administrator and published in the Federal Register. Such a request applies to pumps, compressors, sampling connection systems, open-ended valves or lines, valves, pressure relief devices, product accumulator vessels and closed-vent systems and control devices. Such requests should be forwarded to the Emission Standards and Engineering Division (ESED) for review and approval.

No Detectable Emissions

Pumps pursuant to §61.192-2(e), compressors pursuant to §61.192-3(i) and valves pursuant to §61.192-7(f) may be designated for no detectable emissions, indicated by a Method 21 instrument reading of less than 500 ppm above background. These pieces of equipment would be exempt from other requirements, as specified. Pressure relief devices in gas/vapor service and closed-vent systems must be designed for and operated with no visible emissions, with compliance determined by Method 21. Compliance of flares with the no visible emissions standard, as provided at §61.192-11(d), shall be determined by Reference Method 22.

Peformance tests shall be conducted a minimum of once per year, except for pressure relief devices and flares. Pressure relief devices shall be tested no later than five calendar days after each pressure release. Flares shall be monitored with an appropriate heat sensor, such as a thermocouple, to ensure the presence of a flame. Also, flares must be a smokeless operation, as evidenced by visible emissions for a maximum of 5 minutes in any 2-hour period.

Reporting Requirements

Reporting requirements, described under §61.197, are of two types. The first is an initial report, and the second a series of semiannual reports. An initial report must be submitted within 90 days of the effective date for existing sources or new sources having an initial startup date preceding the effective date. For new sources with a startup date after the effective date, the initial report must be submitted with the application for approval of construction, as described in §61.07.

Receipt of the initial report is essential for ensuring compliance with this standard. The report must specify equipment identification number and process unit identification, type of equipment, percent by weight benzene in the equipment fluid, process fluid state (gas/vapor or liquid), and method of compliance with the standard (monthly leak detection, no detectable emissions, etc.).

Semiannual reports of leak detection and repair efforts within a process unit are required. The reports must include the number of leaks occurring within the process unit during the reporting period, the number of leaks that could not be repaired within 15 days, and the general reasons for unsuccessful or delayed repair past 15 days. Reports may be photocopies of reports under other regulations, provided the informational requirements of §61.197 are satisfied.

Recordkeeping Requirements

These are specified at §61.196. Each leak shall be identified and tagged, and this must be retained until the leak is repaired. When each leak is detected, records should be kept of the equipment and operator identification numbers, dates for detection and repair, method of repair, and any reason for delay of repair. These must be kept for two years. Recordkeeping pertaining to the design requirements for closed-vent systems and control devices must be recorded in a log and kept in a readily accessible location. This recordkeeping includes detailed schematics, design specifications, a description of the parameters monitored to ensure proper control device operation and maintenance, periods when the closed-vent sytems and control devices were not operated as designed, periods when a flame pilot light did not have a flame, and dates of startups and shutdowns of the systems. Additionally, records must be kept explaining why valves have been classified as unsafe or difficult to monitor and providing plans for monitoring such valves. Records must be kept showing analyses demonstrating that equipment is not in benzene service.

Compliance Issues

Compliance is determined by review of records required by §61.196, review of performance test results, and inspections (EPA/State leak detections) using the methods and procedures specified in §61.195. There are, however, several potential compliance issues for which guidance is provided here.

1. For purposes of determining the percent benzene content, §61.195(d) provides that ASTM Method D-2267 shall be used or an owner or operator may use engineering judgment to demonstrate that the percent benzene content does not exceed 10 percent by weight. In case of a dispute the ASTM method takes precedence. It should be noted that each piece of equipment within a process unit that can conceivably contain equipment in benzene service is presumed to be in benzene service unless an owner or operator demonstrates otherwise. For a piece of equipment to be considered not in service, it must be determined that the percent benzene content can be reasonably expected never to exceed ten percent by weight. The burden is on the owner or operator to show equipment is not in benzene service.

2. Several benzene equipment standards require that the owner or operator develop, based on design considerations and operating experience, a criterion indicating system failure. See §61.192-2(d)(5) for pumps and §61.192-3(e)(2) for compressors. The valve standard requires at §61.192-7(g) that the owner or operator have written plans for monitoring unsafe-to-monitor-valves during safe periods and at §61.192-7(h) that the owner

or operator have written plans for monitoring difficult-to-monitor valves at least once per year. Although none of these plans requires EPA approval, all must be accessible to inspection personnel. Should the plan appear inadequate, inspectors may request development of a new plan or a performance test when applicable to ensure compliance is being achieved. If the plan is obviously inadequate (intentionally inadequate), a violation should be pursued.

3. The standard for closed-vent systems and control devices at §61.192-11(e) requires that owners and operators of control devices used to comply with the standard monitor their control devices to ensure they are operated and maintained in conformance with their designs. No monitoring parameters are suggested; however, the owner or operator must achieve 95% control and the parameter selected must indicate this.

The Synthetic Organic Chemical Manufacturing Industry Promulgation Background Document (EPA 450/3-30-033b, June 1982, Appendix B) provides acceptable monitoring parameters and equipment. These include operating temperature or flowrate of fugitive emission vent streams for incinerators, flow recorders to verify steam flow for boilers, thermocouples or ultraviolet beam sensors for flares, temperature and specific gravity of the absorbing liquid for absorbers, offgas exit temperature for condensers, and carbon bed temperature and steam flow recorders for carbon adsorbers. See Attachment II.

Whatever parameter is chosen, the owner or operator should be aware that EPA can require an engineering evaluation at any time to ensure the parameter is appropriate and monitors the operation of the control device in accordance with the standard.

4. The general provisions at §61.10 and 61.11 allow EPA to grant a waiver from a benzene standard for a period of up to two years, if the owner or operator of an existing source subject to that standard is unable to operate in compliance with the standard. Most benzene requirements are in the form of work practice standards, and waivers from these standards would not be appropriate. However, certain provisions may require retrofitting of controls. These include standards for compressors (mechanical seals with barrier fluid systems) pressure relief devices (rupture disk systems or closed-vent systems to flares), and product accumulator vessels (must vent

emissions to a control device or use a closed-vent system). In cases where retrofit controls are necessary, requests for waivers should be examined on a case-by-case basis. Although ESED believes installation of controls should typically take no more than one year, individual situations may require additional time.

Attachment I

Table 9-1. REFINERIES AND ORGANIC CHEMICAL MANUFACTURING SITES WITH BENZENE FUGITIVE EMISSION POTENTIAL[1-15,32-33]

Plant	City/State	Benzene-Related Products At Site[a]	Capacity[b] (Gg/yr)
1. Allied Chemical	Geismar, LA	Et	340
2. Allied Chemical	Moundsville, WV	NiBz	25
3. American Cyanamid	Bound Brook, NJ	NiBz	48
4. American Cyanamid	Willow Island, WV	NiBz[c]	34
5. Amerada Hess	St. Croix, VI	Bz	217
6. American Hoechst	Baton Rouge, LA	EtBz	526
		St	ND[g]
7. American Hoechst	Bayport, TX	EtBz[d]	469
		St[d]	409
8. American Petrofina (of Texas)	Port Arthur, TX	Bz	67
9. American Petrofina (Cosden Oil)	Big Spring, TX	Bz	194
		Cyx	35
		EtBz[e]	20
		St	41
10. American Petrofina (Cosden Oil/Petrogas)	Groves, TX	Et	9
11. American Petrofina/ Union Oil of CA	Beaumont, TX	Bz	73
		Cyx	88
12. Ashland Oil	Ashland, KY	Bz	214
		Cu	181
		Cyx	ND[g]
13. Ashland Oil	Neal, WV	MAN	27
14. Ashland Oil	North Tonawanda, NY	Bz	77
15. Atlantic Richfield	Beaver Valley, PA (Kobuta)	St	200
16. Atlantic Richfield	Channelview, TX	Bz[c]	107
		Et (2 units)	1179

Table 9-1. REFINERIES AND ORGANIC CHEMICAL MANUFACTURING SITES WITH BENZENE FUGITIVE EMISSION POTENTIAL (CONTINUED)

Plant	City/State	Benzene-Related Products At Site[a]	Capacity[b] (Gg/yr)
17. Atlantic Richfield	Wilmington, CA	Bz Et	40 45
18. Atlantic Richfield (ARCO/Polymers)	Houston, TX	Bz[c] Et EtBz St	140 227 61 54
19. Atlantic Richfield (ARCO/Polymers)	Port Arthur, TX	EtBz	114
20. Charter International	Houston, TX	Bz EtBz	17 16
21. Chemetics International	Geismar, LA	NiBz	173
22. Chemplex	Clinton, IO	Et	227
23. Cities Service	Lake Charles, LA	Bz Et (2 units)	83 400
24. Clark Oil	Blue Island, IL	Cu	50
25. Coastal States Gas	Corpus Christi, TX	Bz Cu[e]	234 64
26. Commonwealth Oil	Penuelas, PR	Bz Cyx EtBz[e]	618 117 73
27. Continental Oil	Baltimore, MD	LAB	122
28. Continental Oil	Lake Charles, LA	Et	302
29. Core-Lube	Danville, IL	BSA	ND[g]
30. Corpus Christi Petrochemicals	Corpus Christi, TX	Bz[d] Et[d]	100 544
31. Cos-Mar, Inc.	Carrville, LA	EtBz St	690 590
32. Crown Central	Pasadena, TX	Bz	77
33. Denka (Petrotex)	Houston, TX	MAN	23
34. Dow Chemical	Bay City, MI	Bz Et	100 86

Table 9-1. REFINERIES AND ORGANIC CHEMICAL MANUFACTURING SITES WITH BENZENE FUGITIVE EMISSION POTENTIAL (CONTINUED)

Plant	City/State	Benzene-Related Products At Site[a]	Capacity[b] (Gg/yr)
35. Dow Chemical	Freeport, TX	Bz	167
		Et (5 units)	1136
		EtBz	794
		St	658
36. Dow Chemical	Midland, MI	ClBz	129
		EtBz[e]	249
		St	181
37. Dow Chemical	Orange, TX	Et	375
38. Dow Chemical	Plaquemine, LA	Bz[d]	200
		Et (2 units)	545
39. Dupont	Beaumont, TX	NiBz	159
40. Dupont	Gibbstown, NJ	NiBz	110
41. Dupont	Orange, TX	Et	374
42. Eastman Kodak	Longview, TX	Et	580
43. El Paso Natural Gas	Odessa, TX	Et	ND[g]
		EtBz	125
		St	68
44. El Paso Products/ Rexene Polyolefins	Odessa, TX	Et	236
		St[c]	47
45. Exxon	Baton Rouge, LA	Bz	234
		Et	816
		EtBz	ND[g]
		St	ND[g]
46. Exxon	Baytown, TX	Bz	200
		Cyx	147
		Etc	36
47. First Chemical	Pascagoula, MS	NiBz	152
48. Georgia-Pacific	Houston, TX	Cu	340
49. Getty Oil	Delaware City, DE	Bz	37

Table 9-1. REFINERIES AND ORGANIC CHEMICAL MANUFACTURING SITES WITH BENZENE FUGITIVE EMISSION POTENTIAL (CONTINUED)

Plant	City/State	Benzene-Related Products At Site[a]	Capacity[b] (Gg/yr)
50. Getty Oil	El Dorado, KA	Bz Cu	43 61
51. B.F. Goodrich	Calvert City, KY	Et	136
52. Goodyear Tire & Rubber	Bayport, TX	Hqn	5
53. Gulf Coast Olefins	Taft, LA	Et[c]	218
54. Gulf Oil	Alliance, LA	Bz	224
55. Gulf Oil	Donaldsonville, LA	EtBz St	313 272
56. Gulf Oil	Philadelphia, PA	Bz Cu	124 209
57. Gulf Oil Chemicals	Cedar Bayou, TX	Et (2 units)	719
58. Gulf Oil Chemicals	Port Arthur, TX	Bz[c] Cu Cyx	134 204 106
		Et (2 units)	558
59. Hercules	McGregor, TX	ClBz[f]	0.05
60. Howell	San Antonio, TX	Bz	ND[g]
61. ICC Industries	Niagara Falls, NY	ClBz	11
62. Independent Refining Corp.	Winnie, TX	Bz	10
63. Jim Walter Resources	Birmingham, AL	BSA	ND[g]
64. Kerr-McGee Corp.	Corpus Christi, TX	Bz	53
65. Koppers	Bridgeville, PA	MAN	15
66. Koppers	Cicero, IL	MAN	5
67. Koppers	Petrolia, PA	Rcnol	16
68. Marathon Oil	Texas City, TX	Bz	23
		Cu[e]	95
69. Mobay Chemical	New Martinsville, WV	NiBz	61

Table 9-1. REFINERIES AND ORGANIC
CHEMICAL MANUFACTURING SITES
WITH BENZENE FUGITIVE EMISSION POTENTIAL (CONTINUED)

Plant	City/State	Benzene-Related Products At Site[a]	Capa (Gc
70. Mobil Oil	Beaumont, TX	Bz	[illegible]
		Et	[illegible]
71. Monsanto	Alvin, TX (Chocolate Bayou)	Cu	[illegible]
		Et[c]	[illegible]
		EtBz	
		LAB	[illegible]
72. Monsanto	Sauget, IL	ClBz	
		NiBz	
73. Monsanto	St. Louis, MO	MAN	
74. Monsanto	Texas City, TX	Bz	[illegible]
		Et	
		EtBz	[illegible]
		St	[illegible]
75. Montrose Chemical	Henderson, NV	ClBz	
76. National Distillers (U.S.I.)	Tuscola, IL	Et	[illegible]
77. Nease Chemical	State College, PA	BSA[e]	[illegible]
78. Northern Petrochemical	Morris, IL	Et	[illegible]
79. Olin Corporation	Brandenburg, KY	Et	
80. Oxirane	Channelview, TX	EtBz	[illegible]
		St	454
81. Pennzoil (Atlas)	Shreveport, LA	Bz[c]	49
82. Phillips Petroleum	Borger, TX	Cyx	104
		EtBz	[illegible]
83. Phillips Petroleum	Pasadena, TX	Et	
84. Phillips Petroleum	Sweeny, TX	Bz	
		Cyx	[illegible]
		Et (3 units)	[illegible]

Table 9-1. REFINERIES AND ORGANIC CHEMICAL MANUFACTURING SITES WITH BENZENE FUGITIVE EMISSION POTENTIAL (CONTINUED)

Plant	City/State	Benzene-Related Products At Site[a]	Capacity[b] (Gg/yr)
85. Phillips Puerto Rico	Guayama, PR	Bz	367
		Cyx[c]	212
86. Puerto Rico Olefins	Penuelas, PR	Et	454
87. PPG	Natrium, WV	ClBz	ND[g]
88. PPG	New Martinsville, WV	ClBz	64
89. Quintana-Howell	Corpus Christi, TX	Bz[c]	23
90. Reichhold Chemicals	Elizabeth, NJ	MAN	14
91. Reichhold Chemicals	Morris, IL	MAN	20
92. Reichhold Chemicals	Tuscaloosa, AL	BSA	ND[g]
93. Rubicon	Geismar, LA	NiBz	170
94. Shell Chemical	Houston, TX	Et	590
95. Shell Oil	Deer Park, TX	Bz[c]	301
		Cu	326
		Et	681
96. Shell Chemical	Norco, LA	Bz[d]	133
		Et[d]	681
97. Shell Oil	Odessa, TX	Bz	40
98. Shell Oil	Wood River, IL	Bz	150
99. Specialty Organics	Irwindale, CA	ClBz	2
100. Standard Chlorine	Delaware City, DE	ClBz	125
101. Standard Chlorine	Kearny, NJ	ClBz	7
102. Standard Oil (CA)/ Chevron Chemical	El Segundo, CA	Bz	77
		Cu	45
103. Standard Oil (CA) Chevron	Pascagoula, MS	Bz	ND[g]
104. Standard Oil (CA) Chevron	Richmond, CA	Bz	ND[g]
105. Standard Oil (IN)/ Amoco	Alvin, TX	Et (2 units)	907

Table 9-1. REFINERIES AND ORGANIC CHEMICAL MANUFACTURING SITES WITH BENZENE FUGITIVE EMISSION POTENTIAL (CONTINUED)

Plant	City/State	Benzene-Related Products At Site[a]	Capacity[b] (Gg/yr)
106. Standard Oil (IN)/ Amoco	Texas City, TX	Bz Cu EtBz St	284 14 386 381
107. Standard Oil (OH)/ BP Oil	Marcus Hook, PA	Bz	27
108. Stauffer Chemical	Henderson, NV	BSA	4
109. Sun Oil	Corpus Christi, TX	Bz Cu Et EtBz St	127 113 9 61 54
110. Sun Oil	Marcus Hook, PA	Bz	97
111. Sun Oil	Toledo, OH	Bz[c]	164
112. Sun Oil	Tulsa, OK	Bz Cyx[c]	80 83
113. Sun-Olin	Claymont, DE	Et	109
114. Tenneco	Chalmette, LA	Bz EtBz	33 16
115. Tenneco	Fords, NJ	MAN	12
116. Texaco	Port Arthur, TX	Bz Cyx[c] Et	150 117 454
117. Texaco	Westville, NJ	Bz Cu	117 64
118. Texaco/Jefferson Chemical	Bellaire, TX	Et	240
119. Texaco/Jefferson Chemical	Port Neches, TX	Et	238

Table 9-1. REFINERIES AND ORGANIC CHEMICAL MANUFACTURING SITES WITH BENZENE FUGITIVE EMISSION POTENTIAL (CONTINUED)

Plant	City/State	Benzene-Related Products At Site[a]	Capacity[b] (Gg/yr)
120. Union Carbide	Institute, WV	EtBz	ND[g]
		LAB	64
		St	ND[g]
121. Union Carbide	Penuelas, PR	Bz	ND[g]
		Cu	290
		Et	454
122. Union Carbide	Seadrift, TX	Et	546
		EtBz	154
		St	136
123. Union Carbide	Taft, LA	Bz[c]	234
		Et	500
124. Union Carbide	Texas City, TX	Et	546
125. Union Carbide	Torrance, CA	Et	73
126. Union Oil of CA	Lemont, IL	Bz	57
127. Union Pacific/ Champlin	Corpus Christi, TX	Bz	33
		Cu[d]	ND[g]
		Cyx	65
128. U.S. Steel	Neville Island, PA	MAN	38
129. USS Chemicals	Houston, TX	Et	227
130. Vertac/Transvaal	Jacksonville, AR	ClBz	ND[g]
131. Witco Chemical	Carson, CA	LAB	20

[a]BSA = Benzenesulfonic Acid
Bz = Benzene
ClBz = Chlorobenzene
Cu = Cumene
Cyx = Cyclohexane
Et = Ethylene
EtBz = Ethylbenzene
Hqn = Hydroquinone
LAB = Linear Alkylbenzene
MAN = Maleic Anhydride
NiBz = Nitrobenzene
Rcnol = Resorcinol
St = Styrene

Table 9-1. REFINERIES AND SYNTHETIC ORGANIC CHEMICAL MANUFACTURING SITES WITH BENZENE FUGITIVE EMISSION POTENTIAL (CONCLUDED)

[b]Annual capacities for each product were obtained from the following sources (effective date of capacity in parentheses):

BSA - Ref. 3 (January 1977)
Bz - Refs. 3 (January 1977), 14
ClBz - Refs. 4 (January 1977), 13, 14
Cu - Ref. 9 (January 1979), 13, 14
Cyx - Ref. 2 (November 1976), 3 (January 1977)
Et - Refs. 5 (1977 year-end), 15 (June 1979), 11, 13, 14, 33
EtBz - Ref. 10 (January 1979)
Hqn - Capacity estimate from industry (1979)
LAB - Ref. 8 (June 1978)
MAN - Ref. 3 (January 1977)
NiBz - Refs. 7, 32
Rcnol - Ref. 6
St - Refs. 1 (1977 year-end), 14

[c]Product unit under expansion

[d]Product unit under construction

[e]Product unit on standby or not currently in use

[f]Product unit in engineering phase

[g]No data available

APPENDIX B
MONITORING METHODS

The standards require that some fugitive emission vent streams be vented through a closed vent system to a control device (that is designed and operated for greater than 95 percent control), such as an incinerator, flare, boiler, or process heater. The standards also require that the control device be monitored to ensure that it is properly operated and maintained. This appendix presents methods for monitoring control devices: incinerators, boilers and process heaters, flares, or product recovery equipment, such as condensers or carbon adsorbers.

Incinerators

Incinerators must be maintained and operated properly if the standard is to be achieved on a continuous basis. The operating parameters that affect performance are temperature, type of compound being incinerated, residence time, inlet concentration, and flow regime. Of these variables, the last two have the smallest effect on the performance of an incinerator. Residence time is a design criterion and is not easily altered after the incinerator is constructed, unless, of course, the vent stream flowrate is changed. At temperatures above 760°C, the type of compound being burned has little effect on the efficiency of combustion.

Continuous monitoring of the incinerator inlet and outlet would be preferred because it would provide a continuous, direct measurement of actual emissions and destruction efficiency. However, EPA is aware of no continuous monitor being used to measure total VOC at incinerators which control fugitive vent streams, probably because each of the many different compounds would have to be identified separately and their concentrations determined. Such a monitoring system would be extremely complex for the determination of individual component concentration and mass flow rates. Moreover, it would be relatively expensive since both inlet and outlet monitors are required to verify that a certain destruction efficiency is maintained.

Monitoring of the incinerator operating temperature provides a reliable measure of the efficiency of the incinerator in destroying organic compounds. Both theoretical calculations and results of monitoring or performance tests show that lower incinerator operating temperatures can cause a significant decrease in VOC destruction efficiency. Temperature recorders are relatively inexpensive, costing less than $5,000 installed. They are easily and cheaply operated. Given the large effect of temperature on efficiency and the reasonable cost of temperature monitors, EPA believes that temperature is clearly easy to monitor and would provide some measure of the uniformity of the operation of the incinerator.

Where a combustion device is used to incinerate only waste VOC streams (and not multiple waste streams from the process unit), flowrate can also be an indirect indication of changes in destruction efficiency since it relates directly to residence time in the combustion device. Flowrates of fugitive emission vent streams are typically small and thus would probably be ducted with other larger streams to the same incinerator. Under these circumstances, the vent stream flowrate (for fugitive emissions) may not always give a reliable indication of the residence time of the fugitive emission vent stream in the incinerator. Simple indication of fugitive emission vent stream flowrate to the incinerator does, however, provide verification that VOC is being routed to the incinerator. Flow recorders, at an estimated installed cost of less than $2,000, are inexpensive and require little maintenance. Therefore, since flow recorders provide verification that organics-laden streams are being routed to the incinerator for destruction and they are inexpensive, flowrate is also a reasonable parameter to monitor the constancy of performance of an incinerator. Flow recorders should be installed, calibrated, maintained, and operated according to the manufacturer's specifications.

Boilers

If a fugitive emissions vent is piped to the flame zone of a boiler (or process heater), it is only necessary to know that the boiler (or heater) is operating and that the waste gas is flowing to the boiler (or heater). Records presently maintained for plant operation, such as steam production records, would indicate operation. Flow recorders could be installed to verify flow of the vent stream to the boiler (or heater). For smaller heat producing units (less than 44 MW (150 million Btu/hr heat input)), combustion temperature should also be recorded to enable verification of optimum operation. Boilers (or heaters) with heat input design capacities greater than 44 MW would not be required to install temperature recorders. These larger units always operate at high temperatures (>1100°C) and stable flowrates to avoid upsets and to maximize steam generation rates. Records that indicate onstream time would be sufficient for these larger boilers (or heaters).

Flares

Because flares are not enclosed combustion devices, it is not practically feasible to measure combustion parameters continuously. Temperatures and residence times are more variable throughout the combustion zone for flares than for enclosed devices and, therefore, such measurements would not necessarily provide a good indicator of flare performance even if measurable. Monitoring of flow rate to the flare is generally unacceptable from a safety point of view since the flow measurement would present an obstruction in an emergency vent line. As a result, flare operation is usually verified by examination of more prominent characteristics.

The typical method of verifying continuous operation of a flare is visual inspection. However, if a flare is operating smokelessly, it can be difficult to determine if a flame is present, and it may take several hours to discover. The presence of a flame can be determined through the use of a heat sensing device, such as a thermocouple or ultra-violet (U-V) beam sensor on a flare's pilot flame. The loss or absence of a flame would be indicated by a low temperature measurement. The cost of available thermocouple sensors ranges in price from $800 to $3,000 per pilot. (The more expensive sensors in this price range have elaborate automatic relight and alarm systems.) Thermocouples used on flares may, however, burn out if not installed properly. The cost of a U-V sensor is approximately $2,000. A U-V system is not as accurate as a thermocouple in indicating the presence of a flame. The U-V beam is influenced by ambient infrared radiation that could affect the accuracy. Furthermore, interference between different U-V beams makes it difficult to monitor flares with multiple pilots. By design, U-V sensors are primarily used to verify the existence of flames within enclosed combustion devices. Therefore, based on cost and applicability, EPA believes thermocouples provide adequate verification of flare operation.

Product Recovery Equipment

Three types of product recovery equipment which might be used in controlling fugitive emissions vents are absorbers, condensers, and carbon adsorbers.

Two operating parameters are the primary determinants of product recovery device operation for an absorber: the temperature and specific gravity of the absorbing liquid. Facilities which have installed an absorber to recover product which otherwise would be lost will generally monitor a parameter which indicates the degree of saturation of the absorbing liquid with respect to the product. Specific gravity is commonly used for this purpose. Devices for measuring the temperature and specific gravity are available at reasonable cost. The estimated one-time combined capital investment for such equipment is $8,000. It is considered reasonable for an operator of a process unit to install, calibrate, maintain, and operate according to manufacturer's specifications the requisite devices to monitoring continuously temperature and specific gravity or such alternate parameters which would indicate the degree of saturation of the absorbing liquid.

In constrast, the exit temperature of the offgas is the primary determinant of the efficiency of a condenser. Again, suitable temperature recorders are available at a reasonable cost. The estimated one-time capital investment is $3,000. A record of the outlet temperature would verify that the condenser is properly operated and maintained. EPA believes an operator can install, operate, calibrate and maintain according to the manufacturer's specifications a temperature recorder to verify proper operation of a condenser.

The operation of a carbon adsorber can be monitored by the carbon bed temperature and the amount of steam used to regenerate the bed. Steam flow meters and temperature recorders are available at reasonable cost. The estimated one-time capital investment for such equipment is $10,000. These parameters could be monitored to reflect whether the carbon adsorption unit has been consistently operated and properly maintained. Therefore, EPA believes that an operator of a carbon adsorber used as a pollution control or product recovery device could install, calibrate, maintain, and operate according to manufacturer's specifications an integrating steam flow recorder and a carbon bed temperature recorder. Some operators may install vent stream analyzers to aid in maximizing the recovery of organic compounds. No widely accepted performance specifications have been developed for such analyzers. If an analyzer is installed without a recorder, the vent stream should be sampled at the end of the adsorption cycle (at least once during every 4 hours of operation) and the concentration recorded as a means of verifying that operational modes remain consistent with the conditions under which the performance test was conducted.